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REPORT OF ORIJARVI MINES OF FINNISH-AMERICAN MINING CO.

Gentlemen:

In accordance with your cabled instructions, received by me at Mosjen, Norway, on September 1st, I visited and made an examination of your mine, Orijarvi, situated in south central Finland, on the estate Fiskars.

This mine is in Kiso parish, the province of Abo, and is situated conveniently for transportation, being but 18 English miles from a good harbor on the Gulf of Finland and 16,000 meters (10 English miles) over a surveyed and thoroughly practicable railway line from the state railroad between Helsingfors and Turku. Good public roads reach the property, and it is also situated in a general region that is highly cultivated and of a moderate climate, and that many forests containing timber suitable for mining and building purposes. Provisions are low in price, labor is ample and good, and the district is convenient and favorable for mining operations.

Historically these mines are of exceeding interest. They are old and of long continuance, since openings were made there in 1757 and mining was continued for 118 years without interruption. The settlement of estates, deaths and diverse outside interests on the part of the chief owners, then combined to close them down. They filled with water and were idle for many years. One or two attempts were made to reopen the mines at times subsequent to 1870, but by men of small capital or slight experience, and these failed. It was not until the present company took hold, three years ago, that operations became permanent and were conducted on a scale commensurate with the possibilities of the properties. Since then the old mines have been unwatered, suitable modern machinery equipment placed thereon, a shaft constructed in one of the great pits left by former miners, and a very considerable amount of exploration and development was carried along. Mining in Finland in the early days was quite a new and unknown occupation, and there was not that knowledge, care and detail that would now characterize operations. For this reason the early maps and records are not full nor complete, nor are there the general historical accounts of this mining property that one would look for. The district was practically unknown to all but those in the immediate vicinity until the present American company took hold of it.

In the report of Mr. Otto Trustedt on the Ore Fields of Orijarvi, and published by the Geological Commission of Finland in 1909, is a list of the few reports and pamphlets that refer to this property. Prefacing his bibliography Mr. Trustedt says: "The literature about this, both geologically and mineralogically, very interesting mining field, is very scarce. There does not exist any comprehensive history about the ore fields of Orijarvi, a want that has been keenly felt whenever this well known 'unknown' mining field was to be described by foreign mining geologists.

Even in the very latest textbooks about Orijarvi there is given scarcely anything but the name."

Owing to the fact that the early miners in this field knew nothing of tramming ore horizontally to shafts for hoisting to surface, or had no facilities for such work, the mine was opened by a series of truncated conical caves, the smaller end of the cones being at surface opening gradually growing larger in section as they increased in depths. Buckets hung on ropes were let down and were swung as far to the sides of the opening as possible, in order to reach ore in as wide a radius as might be. When these buckets could be swung no further, and ore could not be thrown into them, no drifts were run and no ore was trammed to the bottom of the opening for hoisting vertically, but another bottle shaped shaft was started close by and the former process carried on again. In a space of but a few hundred feet in diameter there exist half a dozen of these caverns. All this had a two fold result. In the first place an enormous amount of waste rock was broken, mined and hoisted to the surface, as it was necessary that each new cone go down through all barren rock that might be in its course in order to encounter the enriched portions of the vein; and in the second place there were doubtless large quantities of good ore left by those early miners, which they were unable to take away. And, for the same reason they were forced to mine whatever came to hand, being unable to make what we would now call a close selection. The first result is shown in the vast piles of rock on surface, considered waste by them, but containing great values in other minerals than copper; and the second in the appearance of the mine underground.

Other unfavorable conditions surrounded their operations among them the want of candles or other suitable light, forcing them to use long splinters of dry pine and thus so filling their workings with smoke that the time of a full day's work, or energetic work during the shortened period of labor, were alike impossible. Then, too, much of their total of openings was made by means of fire laid against the rock walls, powder not being available. This aided in making progress very slow and filled the mines with gases and smoke.

That the early miners were able to make such a success of Orijarvi for so many years, and could accomplish as much their total product of refined copper during the period is estimated from the best records available at from 9,000,000 to 10,000,000 pounds, is a matter of no little interest and importance in connection with the future conduct of the property.

The ore deposits of Orijarvi are situated against the northerly limb of a great anticline of granite that has had the effect of pushing the deposits and ore bearing formation to the north, as they proceed in depth. I consider this granite as the true footwall of the formation, and diorite as the hanging. It is presumed by Tigerstedt (Finnish Geologiska Kommissionen) that this ore is what is called secondary, that is, later in origin than the surrounding rocks, and under influence associated with the diorite outburst that stretches along to the north of the main ore carrying formation. In this case the ore can be regarded as quite deep-seated, and of considerable permanence. It is, to be sure, entirely probable that the formation footwall of granite and the hanging wall of diorite will, at some unknown but greater depth, come together, cutting out the opportunity for ore deposition. Should this occur, the mine will then cease But this is not liable to happen for such depth that we need concern ourselves little about it. It is not a matter of present importance.

Diamond drilling and other explorations seem to show that the best ores lie near the diorite. This body of diorite is strong and, from its very nature it must naturally be very deep, and if the mineralization is to be associated with it, and results from it, as Finnish geologists believe, there is all reason to expect the latter to be important as well. The diorite dyke crosses a massive intrusion of quarts felsite at an oblique angle and in a course roughly parallel to the granite anticline. In this softer material the original solutions forming the ore have deposited themselves and concentrated. The many movements of the earth necessary to bring these several types and ages of eruptive rocks into their present positions were tremendous, and have resulted in grinding and decomposing and softening the rocks of the felsite layer to a most marked degree. This makes the felsite more amenable to the action of the copper bearing solutions or gases than it would otherwise have been, or than the facility with which copper was concentrated.

Copper ores found in these mines are a valuable sulphide technically called chalcopyrite, with some pyrrotite, or magnetic iron sulphide, and contain a large amount of spalerite, or zinc sulphide, with some lead, and they are, more or less, gold and silver bearing. The tract of land upon which this mine is situated is a large one, extending for several miles, and while mining developments have been confined to a distance of some 550 feet along the strike of the deposit similar ore was encountered along this strike and more than half a mile away somtime prior to my visit, this fall. The intervening country is covered by soil, but the geology has been traced through, connecting the two workings, across a swampy depression, resulting from the erosion of the softer felsite, and there seems no doubt that the formation at the northwesterly pits is the same as at the main workings. The rock appearance of the two, so far as they can be seen, are almost precisely similar. I am told that off to the southwest, on an island in Lake Ori, the same formation comes to the surface. It has, therefore, a very considerable length. Indeed the geological chart shows a succession of diorite dykes, cutting, or being cut by, other igneous rocks of both older and younger ages. These may possibly materially extend the copper bearing area.

Investigation by diamond drilling has shown that there are large bodies of copper ore beneath the old bottom of the mine. Work by the present management, so far as it has been carried in the direction of these drill holes, has proved their correctness, and that the ore cut by No. 5 drill hole extends upwards to the old workings. It would appear from the probable origin of the ore and from these drill holes that the better ore will be found near the diorite hanging walls, and that the ore lessens of various sizes and grades are liable to be found from points quite near the surface of the ground to a depth much below the present bottom of the mine.

At this company's "Bradtorp" property, located in the parish of Pohja, near Skuru station on the line of the Helsingfors Turku railway, and some four miles from Orijarvi, some work has been done. The formation is a lime and diorite contact, and high grade zinc ore has been taken out to quite a depth along this contact, and also in a number of pits and openings stretching for a distance of several hundred feet. All these pits and the main shaft were filled with water at the time of my visit, and could not be examined. I was told that the shaft was more than 100 feet deep, and that a drift running for 40 feet along the contact, at the depth of 80 feet from surface, had resulted in the hoisting of some 250 tons of zinc ore ranging from 20 per cent. up. Also that a drill hole sunk to test the lode showed the ore continue deeper. Much of this high grade zinc ore is lying on surface at the property. It is stated that there is almost a continuous outcropping of the diorite and to some extent also of the lime, between this property and Orijarvi, four miles away. But as to this my information is entirely hearsay.

These ores, at Orijarvi, being a combination of copper, zinc and lead and quite silicious, are very base and require careful treatment. In the early days nothing but their copper could be handled, but conditions have changed, and it is now possible to extract the bulk of the zinc as well as the copper. This is fortunate, as the mine contains a great tonnage of high grade zinc ores, while many thousand tons of zinc were mined and are now on the surface of the ground. This latter was the result of early mining, and was material thrown aside as waste. President John Daniell, of this company, estimates that there are some 8,500 tons of this zinc ore on the ground, of which 750 tons are of an average percentage of about 33 zinc, 6,700 tons will average 21,43 per cent, and the rest about 9 per cent. I consider these estimates, especially for the quantity of first class ore, too low, and from my investigation am of the opinion that the dumps contain not less than 1,500 tons of 30 per cent. zinc, and probably 7,000 tons of 20 per cent., while concentration of the piles containing ore as low as 5 or 6 per cent. zinc will result in the saving of a great deal more, and at a fair profit.

It is noticeable that in this mine the higher grade zinc is quite well separated from the copper, so that it will be possible to mine by far the larger proportion of the zinc practically free from copper, or free from any such percentage of copper as would be worth separation. This will greatly simplify the treatment of these ores as another, neither being penalized seriously for its proportion of the other. The mine is 18 miles from tide water, where cargoes can be loaded for shipment direct by water, to zinc buying and smelting works in Germany and Wales.

The mines have been developed under old and unskilled methods, and with little regard for the safety of the miners, for the blocking out of ore bodies for future operations, or for the extraction of valuable ores with the minimum of labor in the removal of waste rock. The deepest of the great bottle shaped pits is nearly 300 feet down, and on the 30 meter level (about 90 feet) lateral developments are 550 feet long on the course of the formation. By reason of the manner of working it was necessary that very large and frequent pillars be left in the mine, and these contain more or less ore, probably much, though how great is this quantity cannot be ascertained until more development has been carried out. On the walls of some of these pillars high grade ore is still in place. The great pillar "Elephant" is surrounded by water but this has probably a quantity of ore. In addition to what may be in these pillars, and which can be pretty completely mined out by the use of modern and carefully conducted methods, ore is to be seen at other parts of the former openings, especially in the Smedje portion of the mine, where some excellent faces remain. There is a large tonnage in these faces. Development work carried on beneath the Smedje drift proves the ore to continue in depth and in high grade. A series of diamond drill borings was carried out by the government some years ago, and these have proved the continuous existence of copper ores for a depth, beneath the Smedje bottom, of about 100 feet, in one hole, which continued in good ore till the boring reached the side wall; to a vertical depth of 180 feet. The first of these holes is continually in rich ore; the second continually in mixed ore, except where seams of barren rock, in which latter material it was stopped. This latter hole was driven at an angle away from the diorite contact, a fact that argues well for the persistence, and strength of ore lessons at that point.

These favorable holes are all near the eastern end of the mine and are in the same high grade copper zinc ores that were exposed by the early miners when operations ceased. Similar drill holes in the western end of the mine were not as successful, resulting negatively. This does not necessarily indicate that that portion of the mine is worthless, but taken into consideration with the underground maps, which also show less ore at that end, it is suggestive, and shows the need of thorough exploration before any ore bodies can be expected there. Such exploration should be carried out. In my opinion some ore can be expected there, as the result of exploration, for I see no reason to look for the mine to play out in that direction. The most distant of the main workings should be reopened and carefully examined.

But the holes that have shown ore have proved about 125,000 tons of minable ore. As the cores of these drill holes were not available at the time of my examination it is impossible to state the percentage of copper contained in the rock, but if one may judge from previous results of work at this mine and by the former returns, he will agree with the estimate of Mr. Trustedt, who computes an average copper content of 4 per cent., or 80 pounds to the ton, or a total in the 125,000 tons of 10,240,000 lbs. copper metal. All this is what may be classed as probable ore. It is in addition to whatever copper is to be mined from the ground above the bottom of the old mine and which ground is estimated at a total of 600,000 tons, a part of which contains mineral ore of some grades but the larger shares of which is not available, and of no worth. I shall assure not less than 50,000 tons of copper bearing ground in this part of the mine, making a total copper content there amounting to 3,000,000 pounds. On account of the condition of the mine underground and the slight amount of development that can be considered in proving this tonnage, it must also be classed as "probable ore."

I will make no calculation of possible ore in this mine, for the reason that it is utterly impossible to arrive at any basis for estimates. It may be stated definitely that the ore continues below the bottom of drill holes, but as these are 100 feet and more below any point where the geological condition can be examined one would not care to prophesy further, except to say that the chances are for a considerable continuance of the enriched area.

During the old work the zinc ores

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